

Guidance for Option D – Practical 1

Determining the energy content of food by combustion

Safety

Although great care has been taken in checking the accuracy of the information provided in this guidance, Cambridge University Press shall not be responsible for any errors, omissions or inaccuracies.

Teachers and technicians should always follow their school and departmental safety policies. You must ensure that you consult your employer's model risk assessments and modify them as appropriate to meet local circumstances before starting any practical work. Risk assessments will depend on your own skills and experience, the skills and experience of your students, and the facilities available to you. Everyone has a responsibility for his or her own safety and for the safety of others. The notes below should not be regarded as a risk assessment.

You should carry out the practical yourself before presenting it to students. Make sure you are comfortable with the procedures, and can anticipate any difficulties any of your students may encounter.

Guidance

The energy content of food is measured by calorimetry and students should be familiar with the notion of 'calories' in food from manufacturers' labels. In this experiment they can attempt to estimate energy content of some foods using a simple calorimeter. Although the methodology is not sophisticated, the concept that energy must be converted into a measureable state (heat) and estimated from a change in temperature is important. The practical also provides a valuable opportunity for students to consider heat losses and their contribution to the inaccuracy of the method.

Apparatus and materials

Each student or pair will need:

- peanuts (if no students have allergies), croutons, samples of other suitable foods
- temperature probe and interface to computer, or thermometer and stopwatch
- small can or boiling tube that will hold 50 cm³ water
- stirrer
- suitable holder for food sample (e.g. a mounted needle)
- retort stand
- matches and wooden splints
- access to weighing scales

Setting up the practical

The foods chosen should be easy for students to handle. Peanuts or other nuts are suitable, provided there are **no students with allergies** in the group. Croutons or corn snacks are good substitutes. Foods that contain fat will burn more easily than those that do not.

A 50 cm³ container of water is suggested but this can be adjusted if food samples are small.

Supporting the practical

It will be helpful to emphasise the difference between the popularly used term 'calories' from diets and food labels, and the SI unit of energy, the joule (J), which is the unit they should be using in their studies.

Answers to questions

- 1–3** Students' calculations will depend on their findings.
- 4** Students may suggest heat losses to the air around the flame, to the container, and through the top of the container. These losses are all affected by the room temperature, the distance of the food from the water being heated and convection currents.

Guidance for Option D – Practical 2

Investigating the effect of exercise on heart rate

Safety

Although great care has been taken in checking the accuracy of the information provided in this guidance, Cambridge University Press shall not be responsible for any errors, omissions or inaccuracies.

Teachers and technicians should always follow their school and departmental safety policies. You must ensure that you consult your employer's model risk assessments and modify them as appropriate to meet local circumstances before starting any practical work. Risk assessments will depend on your own skills and experience, the skills and experience of your students, and the facilities available to you. Everyone has a responsibility for his or her own safety and for the safety of others. The notes below should not be regarded as a risk assessment.

You should carry out the practical yourself before presenting it to students. Make sure you are comfortable with the procedures, and can anticipate any difficulties any of your students may encounter.

Guidance

Students will intuitively realise that their heart rate increases with increasing exercise but this practical enables them to quantify this and attempt to devise a methodology that produces accurate, comparable heart rate data. The change in heart rate between a seated and a standing position will surprise some.

If the work can be conducted in a gym, students can devise their own programme of exercise to examine.

The heart rate of very fit athletes and average students can be compared using data from an elite athlete. The lower heart rate of an athlete can lead to discussion of what constitutes fitness and how it can be gained through training and lost very quickly without it.

Students should undertake exercise appropriate to their own level of fitness in this practical. Those suffering from medical conditions such as asthma, which restrict their activity, should be identified and excluded if necessary.

Apparatus and materials

Each student or pair will need:

- stopwatch
- pencil and paper
- heart rate monitor and data-logger (optional)

Supporting the practical

Students should be reminded to rest between measurements to ensure accurate data is collected. Teachers should make sure the level of exercise being undertaken is appropriate for each individual.

If gym apparatus is used, the intensity and number of repetitions of the exercise (e.g. rowing, cycling, running) can be used to plot graphs of intensity of exercise against heart rate to investigate any correlation.

If sufficient and a suitable range of data are collected, students could be invited to calculate means and standard deviations to support their knowledge of statistics.

Answers to questions

- 1 The heart has to pump harder when a person is standing. The need to supply blood against the pull of gravity may lead to an increase in heart rate.
- 2 Correctly used data-loggers are more likely to be accurate as readings are taken continuously and do not involve the possibility of counting errors. Heart rate monitors attached to running machines can be inaccurate if the connection is made via contact with the hands, because sweat can change the degree of contact.
- 3 If the heart is working at an elevated rate due to previous exercise the new measurement of heart rate will not solely reflect the new exercise pattern being undertaken. It is important to start each exercise at the same heart rate. Students may mention that even if they do rest between activities their muscles may be 'warmed up' from previous activity and this may affect the results too.
- 4 The main reasons for an increase in heart rate during intense exercise are to supply working muscles with oxygen and glucose at the necessary rate and to remove carbon dioxide and waste. When the heart is unable to do this, a period of anaerobic respiration can sustain exercise for a short time, after which it is impossible to continue.